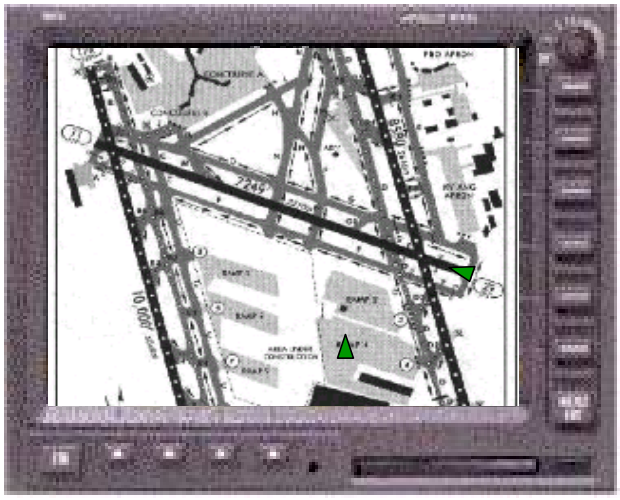
AD-7: Enhance Surface Situational Awareness

Improve surface navigation and traffic situational awareness with cockpit-based tools.

Final Approach, Runway and Taxiway Occupancy Awareness



Background

The pilot uses visual navigation aids and controller communications to determine aircraft position on the runway surface and uses visual references to maintain separation from aircraft and other vehicles. While the controller is responsible for separation on the runway, the pilot is responsible for separation while taxiing to the runway or gate, regardless of airport visibility. Low visibility and reduced ability to see signage can lead to confusion in navigating the aircraft on the surface. This in turn can result in the reduction of safety and efficiency.

Ops Change Description

Cockpit-based tools provide more robust surface navigation increasing pilot awareness of the aircraft's position on the airport surface. These tools help the pilot guide aircraft along the surface in accordance with ATC instructions, or in accordance with a self-generated taxi plan in the case of non-towered airports. Initially, these tools will supplement the pilot's out-the-window visual assessment of the aircraft's position on the surface, its direction, and speed.

A cockpit moving map of the airport surface could use the same moving map/navigation display used in flight. Additional attributes for effective use on the airport surface would be highly accurate own-ship position information (e.g., from augmented GPS), coupled with a comprehensive, accurate digital map of the airport surface (including runways, taxiways, holding areas, ramps, hangars, and prominent airport structures). With this information, pilots can follow their progress on the airport surface using the cockpit display, and correlate that position by reference to outside visual cues.

Other aircraft and surface vehicle traffic would also be displayed on the cockpit moving map for airports providing this added information via Automatic Dependent Surveillance – Broadcast/Traffic Information Service – Broadcast (ADS-B/TIS-B). These enabling technologies are discussed further in AD-6. In normal operations, the pilot would use both the cockpit display and visual observation to develop the most complete traffic picture. In some cases, the display could be the only source of traffic information for the pilot. This might occur when another aircraft cannot be seen due to blind spots created by airport structures or by one's own wings or tail. Aside from its use for avoiding runway incursions and incidents, the pilot can also correlate traffic observed on the display with outside visual information, thereby easing the process of understanding the intended sequencing when several aircraft are being formed into a queue.

As envisioned in the *Surface Technology Roadmap*,[1] cockpit surface moving map technology will progress through four stages of development, with each stage providing additional information to improve the pilot's situational awareness. For the time frame of the OEP, we are using three of the four stages.[2] Each additional stage will utilize new surveillance and data-link technology, as it becomes available.

1. The initial moving map display does not rely on any communication with FAA ground systems, as it includes only the GPS-based position of the current aircraft on a locally stored airport map.
2. The capability to receive and display target reports for other aircraft and ground vehicles is added for airports with Airport Surface Detection Equipment (ASDE)-X (ADS-B/TIS-B) capability.
3. The capability to receive data link of taxi instructions is added based on the interface with Aeronautical Data Link (ADL).

Future commercially available cockpit surface moving map systems will likely be developed with different capability levels and price points reflecting the additional features available in these three stages of development.

The pilot will also be automatically alerted to the status of the runway by visual cues (lighting system) as the aircraft nears a specific runway. This information will be provided by runway status lights.

Benefits, Performance and Metrics

- Faster taxi times at night and under other reduced visibility conditions.
- Average and excess gate times should decrease.
- Reduction in number of runway incursions.

[1] *Surface Technology Roadmap, Presentation to Runway Incursion Joint Safety Implementation Team (JSIT),* presented by David Ford (AND-500), March 7, 2001.
[2] Automatic conflict alerts in the cockpit are not included, but the issues (human factors, training, certification) will be addressed as part of ongoing research activities.

Scope and Applicability

- Several successful demonstrations of the cockpit moving map concept have been conducted.
- Moving maps should provide the same capability to receive and display the same surveillance data to tower controllers, pilots, ramp controllers, and others that are involved with surface operations at the proposed 59 ASDE-X sites.
- Operations fall back to the current mode when position sensor (e.g., GPS-based signal) is not providing adequate accuracy or integrity (depending on the complexity of surface application) or if there is a problem with onboard avionics.
- Until very advanced operations are approved, the surface applications should be in support of the visual maneuvering of the aircraft and should only be used in an advisory role.
- If the bottleneck is at the departure end of the runway, increased throughput on the surface will not result in significant capacity benefits.
- Surface movement and guidance control system is required to support low visibility operations on the surface.

Key Decisions

- Mandating cockpit equipage supporting situational awareness due to safety. Decision to be made by FAA with consultation by aviation community.
- Scheduling of cockpit equipage must be coordinated with airport equipage discussed in AD-6.
- Define funding eligibility under the Airport Improvement Program (AIP).
- Determination of which specific types of ground vehicles are required to equip, by airport, and whether rule making is required.

Key Risks

- Specification of RTCA and international standards for cockpit equipage are on critical path for implementing this operational change.
- Specific applications, operational requirements, and certification requirements need to be identified quickly for implementation in before 2010.
- Equipage costs for users and level of user equipage.
- Procedures (cockpit and ATC) need to be developed and tested at ADS-B OpEval 3 at MEM in 2002.
- End to end performance and safety assessment of new surface architecture (including cockpit).
- Database of airport surface features for display must be accurate and affordable.

- Cockpit human factors/workload issues (heads-down time, surface clutter, day/night visibility, and display scale, heads up/down) need to be addressed in the near-term.
- The availability of a robust surveillance data fusion capability is essential to provide complete and reliable real-time position information of all aircraft and ground vehicles to the cockpit moving map, as discussed in AD-6.